

U2 HP Turbine Upgrade Acceptance Test Results Summary

	<u>Acceptance Tests</u>		<u>Confirmation Tests</u>		<u>Average</u>	<u>Gaurantee</u>	<u>Pre-</u>
	<u>Test 7</u>	<u>Test 8</u>	<u>Test 9</u>	<u>Test 10</u>			<u>Upgrade</u>
HP Turbine Efficiency (%)	92.85	92.83	92.72	92.80	92.80	92.20	83.48
HP TurbineWheel Power (Mw)	302.8	304.5	300.4	304.4	303.01	299.0	259.4
Throttle Flow (kpph)	7,079	7,084	7,063	7,070	7,074	6,900	6,412
IP Turbine Efficiency (%)	92.01	92.06	92.17	91.05	91.82		91.23
Net Turbine Cycle Heat Rate (Btu/kwh)	7,701	7,636	7,671	7,676	7,671	7,683	7,807
Gross Power (Mw)	989.4	989.5	987.8	988.2	988.7	973.2	875.3

Notes:

All tests conducted at turbine throttle valves wide-open.

Tests 7 & 8 conducted by PGT with test instrumentation. Refer to the Thermal Peerformance Test Results on Intermountain Power Project (IPP) Unit #2 Turbine Cycle test report (April 2002) for additional information.

Tests 9, 10 & upgrade tested using station instrumentation corrected to test instruments readings.

HP turbine efficiency - PGT test uncertainty $\pm 0.346\%$, enthalpy drop efficiency calculated with inlet conditions measured before stop valves, exhaust measured after balance gland leakage flow mix.

HP turbine wheel power - PGT test uncertainty $\pm 2.508\%$, throttle flow corrected to design conditions (2412.2 psia, 1000°).

Throttle flow - PGT test uncertainty $\pm 2.510\%$, corrected to design throttle conditions (2412.2 psia, 1000°).

IP turbine efficiency - Enthalpy drop efficiency calculated with inlet conditions measured before combined reheat valves and exhaust measured at LP-A turbine inlet (PGT), 14th stage extraction (Station).

Net turbine cycle heat rate - PGT test uncertainty $\pm 2.554\%$, test heat rate was adjusted to PGT test values and corrected to design throttle & reheat conditions, design turbine back-pressure, and contract cycle using station pepse model.

Gross power - PGT test uncertainty $\pm 0.459\%$, station measurement corrected to PGT test measurements and corrected to design throttle & reheat conditions, design turbine back-pressure, 6.9% reheat pressure drop, and contract cycle using station pepse model.

IP7011153

U2 HP Turbine Upgrade Acceptance Test Results Summary

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Tests 9, 10 & upgrade tested using station instrumentation corrected to test instruments readings.

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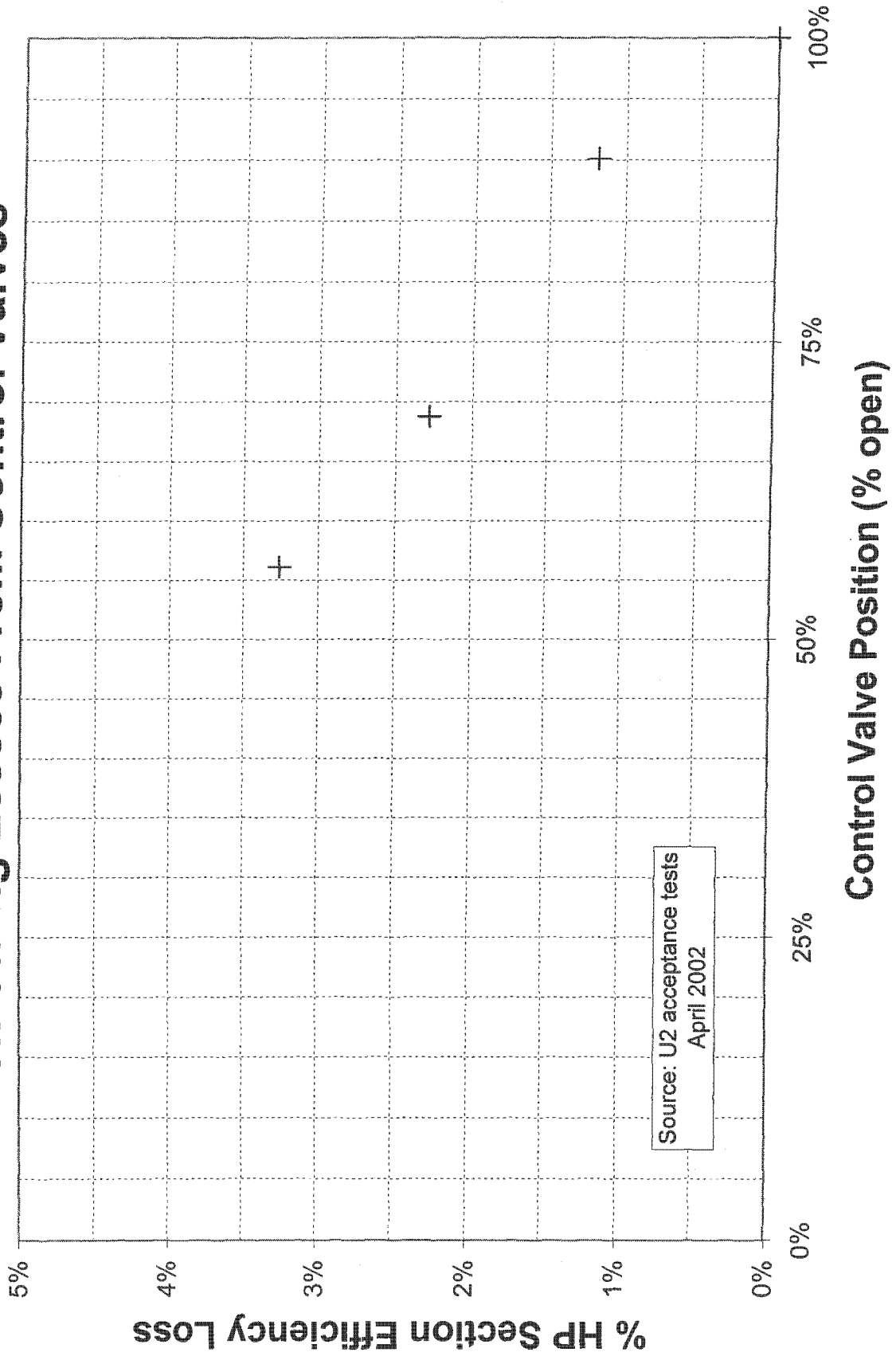
IP turbine efficiency - Enthalpy drop efficiency calculated with inlet conditions measured before combined reheat valves and exhaust measured at LP-A turbine inlet (PGT), 14th stage extraction (Station).

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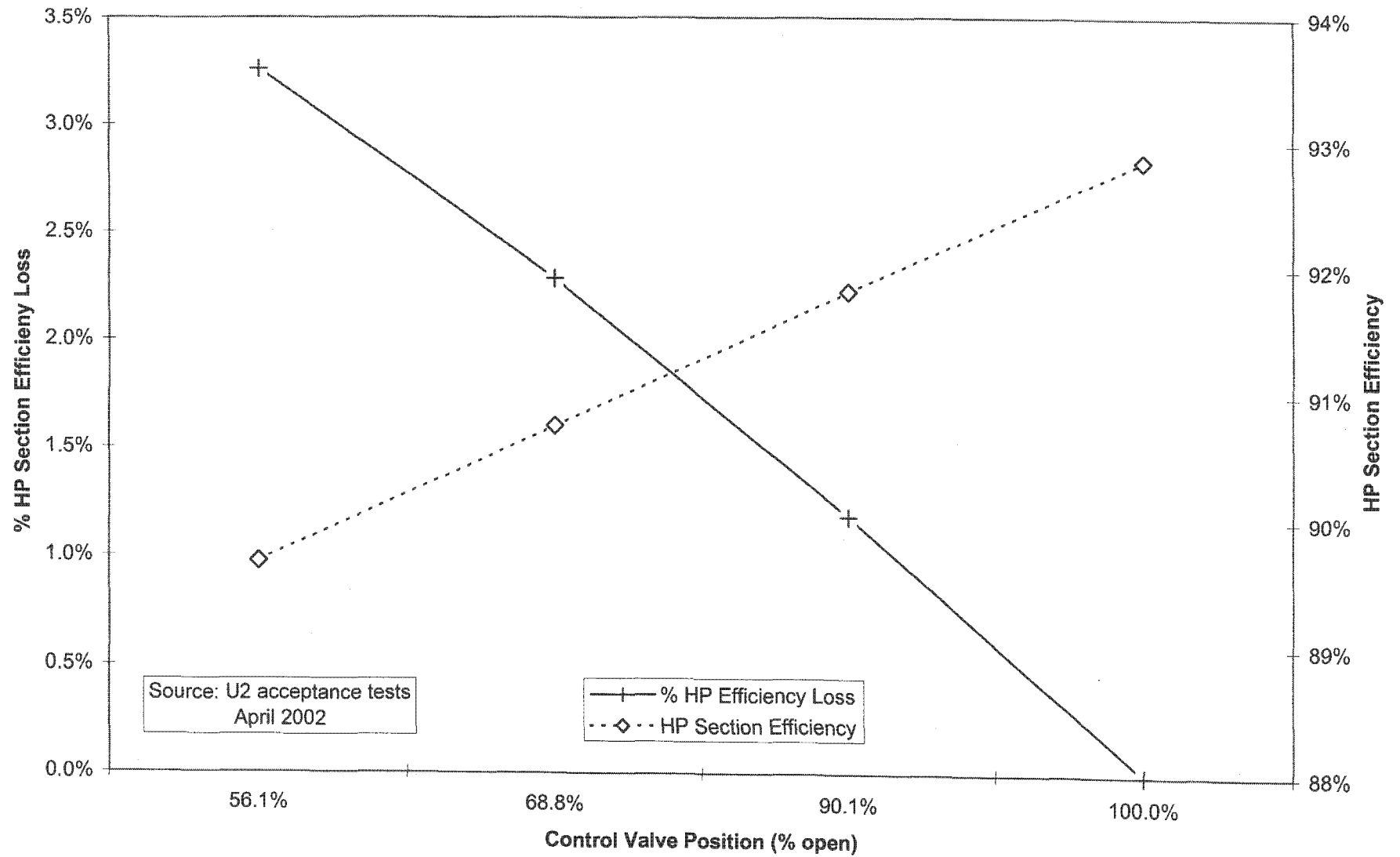
Gross power - PGT test uncertainty $\pm 0.459\%$, station measurement corrected to PGT test measurements and corrected to design throttle & reheat conditions, design turbine back-pressure, 6.9% reheat pressure drop, and contract cycle using station pepse model.

IP7011154

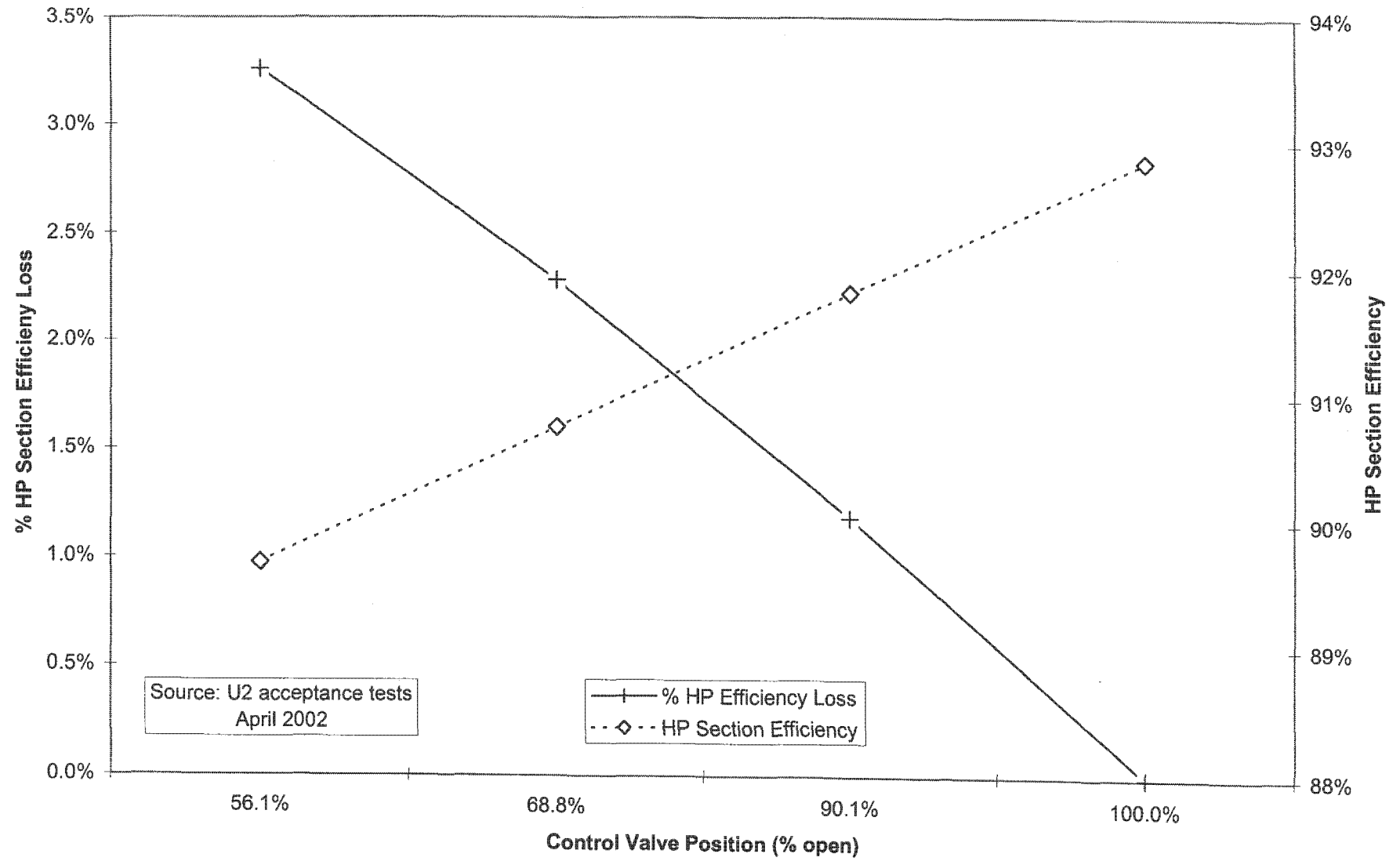
Throttling Losses From Control Valves



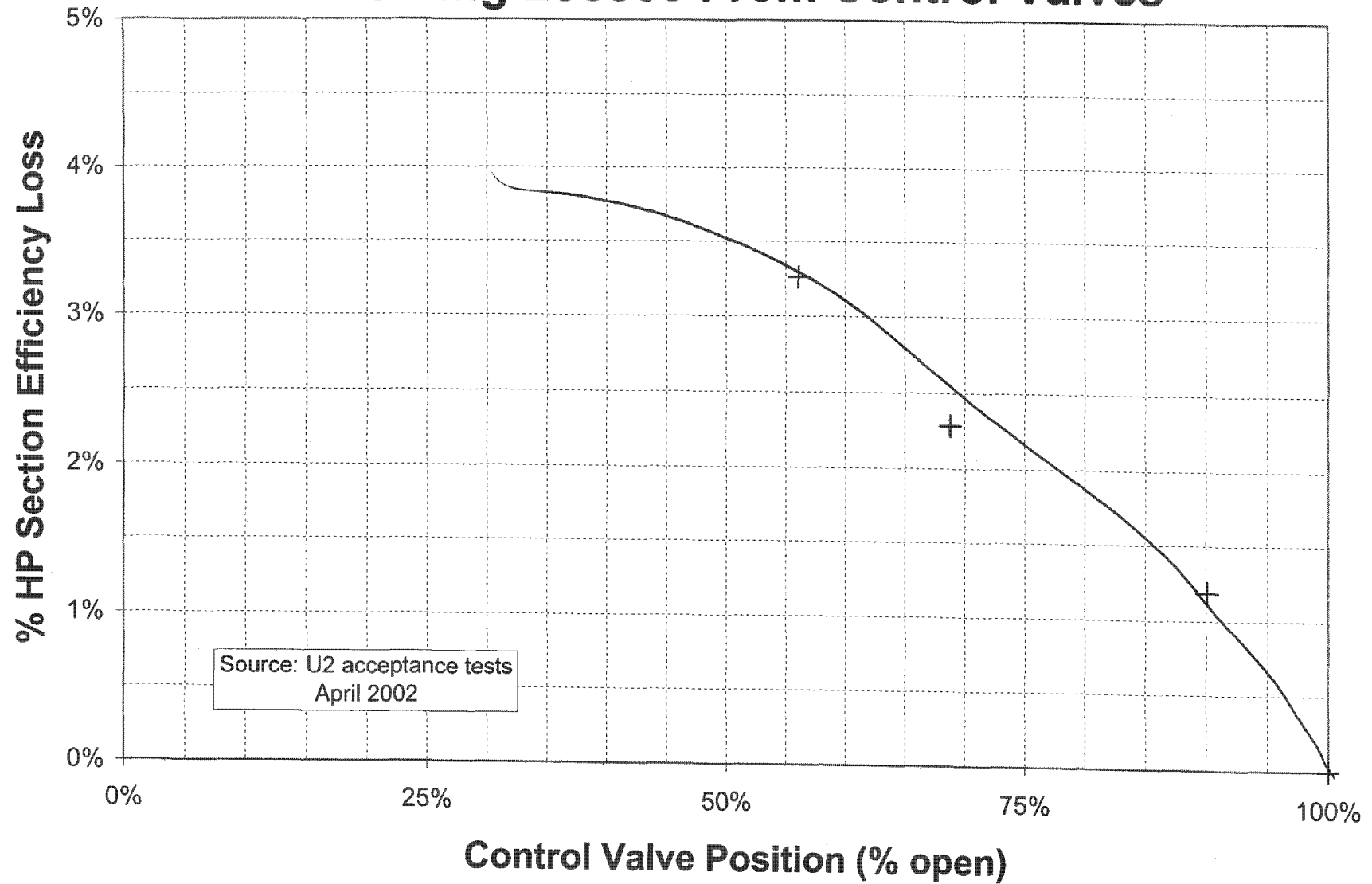
Control Valve Position Effects on HP Efficiency



Control Valve Position Effects on HP Efficiency



Throttling Losses From Control Valves



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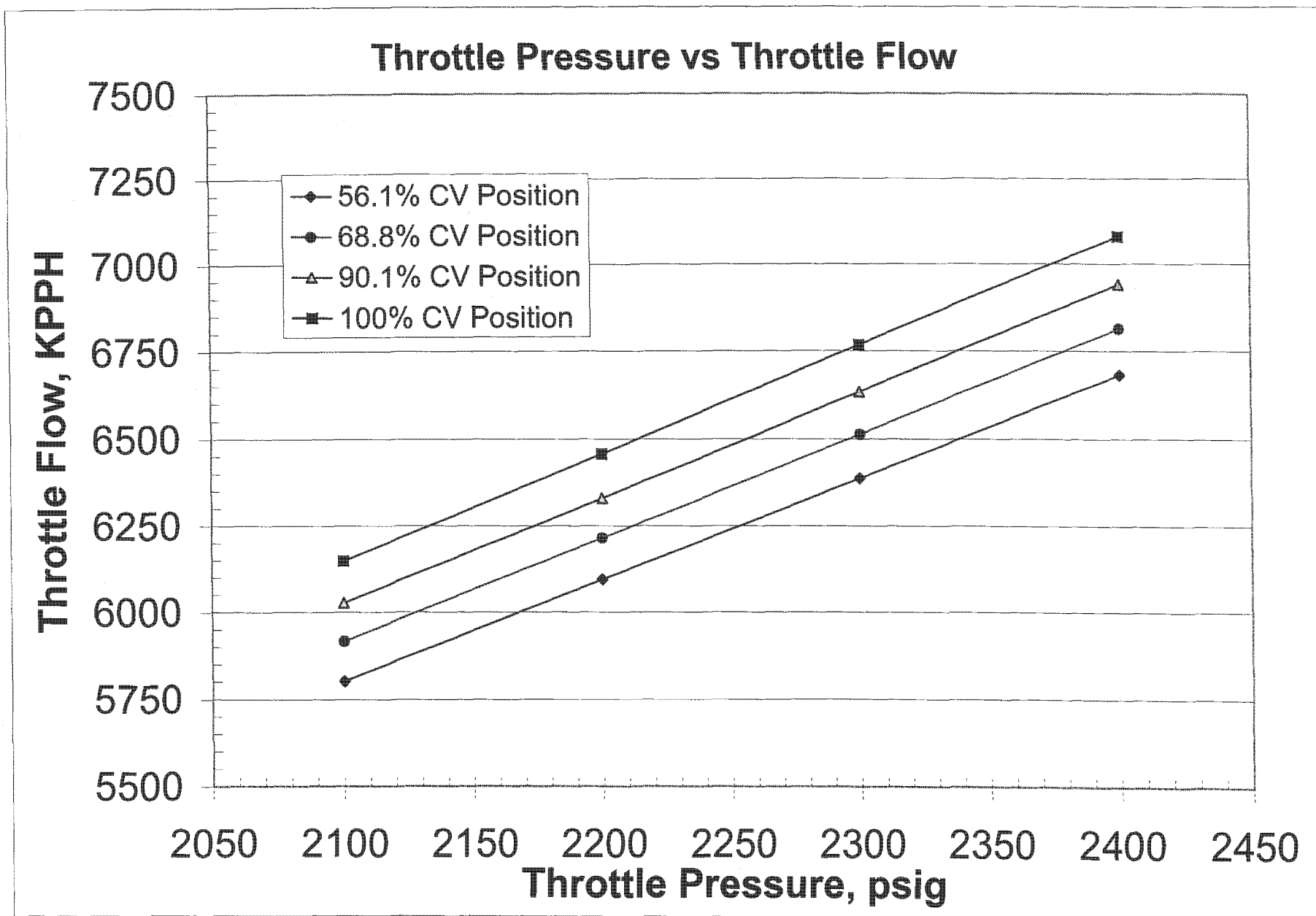
Throttle flow - PGT test uncertainty $\pm 2.510\%$, corrected to design throttle conditions (2412.2 psia, 1000°).

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Net turbine cycle heat rate - PGT test uncertainty $\pm 2.554\%$, test heat rate was adjusted to PGT test values and corrected to design throttle & reheat conditions, design turbine back-pressure, and contract cycle using station pepse model.

Gross power - PGT test uncertainty $\pm 0.459\%$, station measurement corrected to PGT test measurements and corrected to design throttle & reheat conditions, design turbine back-pressure, 6.9% reheat pressure drop, and contract cycle using station pepse model.

IP7011159



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Net turbine cycle heat rate - PGT test uncertainty $\pm 2.554\%$, test heat rate was adjusted to PGT test values and corrected to design throttle & reheat conditions, design turbine back-pressure, and contract cycle using station pepse model.

Gross power - PGT test uncertainty $\pm 0.459\%$, station measurement corrected to PGT test measurements and corrected to design throttle & reheat conditions, design turbine back-pressure, 6.9% reheat pressure drop, and contract cycle using station pepse model.

IP7011161

U2 HP Turbine Upgrade Acceptance Test Results Summary

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All tests conducted at turbine throttle valves wide-open.

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IP turbine efficiency - Enthalpy drop efficiency calculated with inlet conditions measured before combined reheat valves and exhaust measured at LP-A turbine inlet (PGT), 14th stage extraction (Station).

Net turbine cycle heat rate - PGT test uncertainty $\pm 2.554\%$, test heat rate was adjusted to PGT test values and corrected to design throttle & reheat conditions, design turbine back-pressure, and contract cycle using station pepse model.

Gross power - PGT test uncertainty $\pm 0.459\%$, station measurement corrected to PGT test measurements and corrected to design throttle & reheat conditions, design turbine back-pressure, 6.9% reheat pressure drop, and contract cycle using station pepse model.

IP7011162

U2 HP Turbine Upgrade Acceptance Test Results Summary

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Gross power - PGT test uncertainty $\pm 0.459\%$, station measurement corrected to PGT test measurements and corrected to design throttle & reheat conditions, design turbine back-pressure, 6.9% reheat pressure drop, and contract cycle using station pepse model.

IP7011163

U2 HP Turbine Upgrade Acceptance Test Results Summary

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	<u>Test 7</u>	<u>Test 8</u>	<u>Test 9</u>	<u>Test 10</u>	<u>Average</u>	<u>Gaurantee</u>	<u>Upgrade</u>
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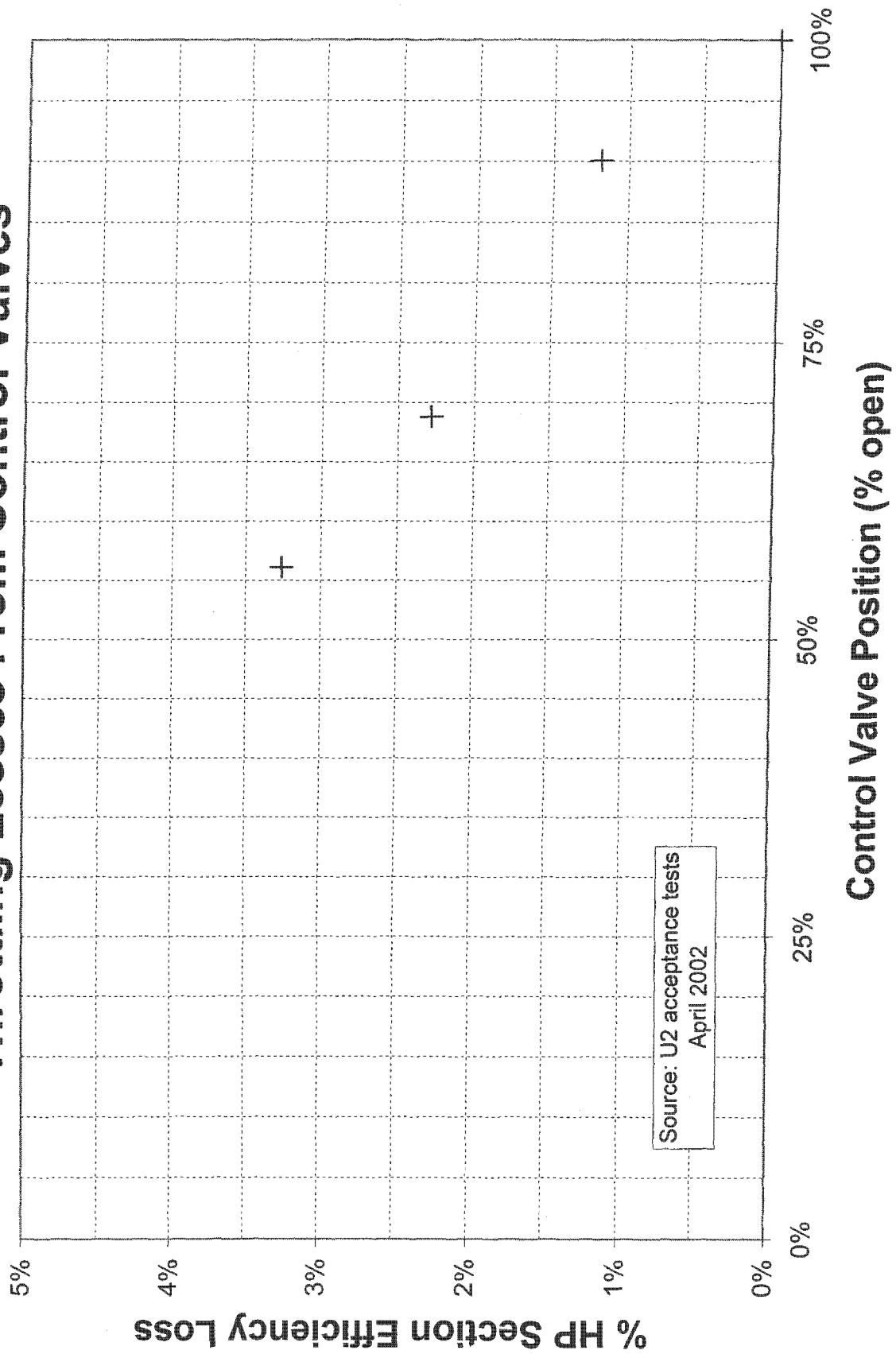
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Net turbine cycle heat rate - PGT test uncertainty $\pm 2.554\%$, test heat rate was adjusted to PGT test values and corrected to design throttle & reheat conditions, design turbine back-pressure, and contract cycle using station pepse model.

Gross power - PGT test uncertainty $\pm 0.459\%$, station measurement corrected to PGT test measurements and corrected to design throttle & reheat conditions, design turbine back-pressure, 6.9% reheat pressure drop, and contract cycle using station pepse model.

IP7011164

Throttling Losses From Control Valves



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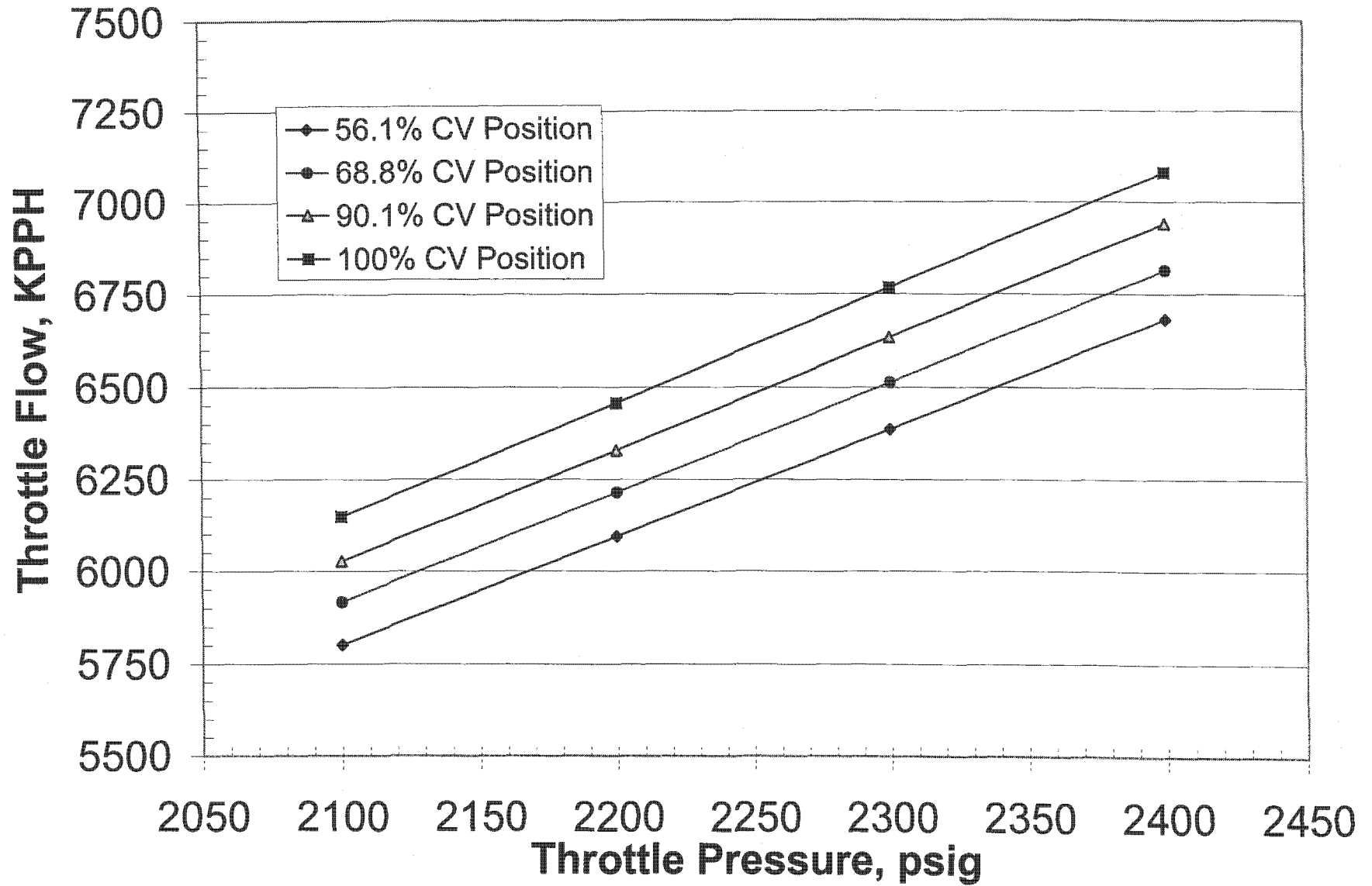
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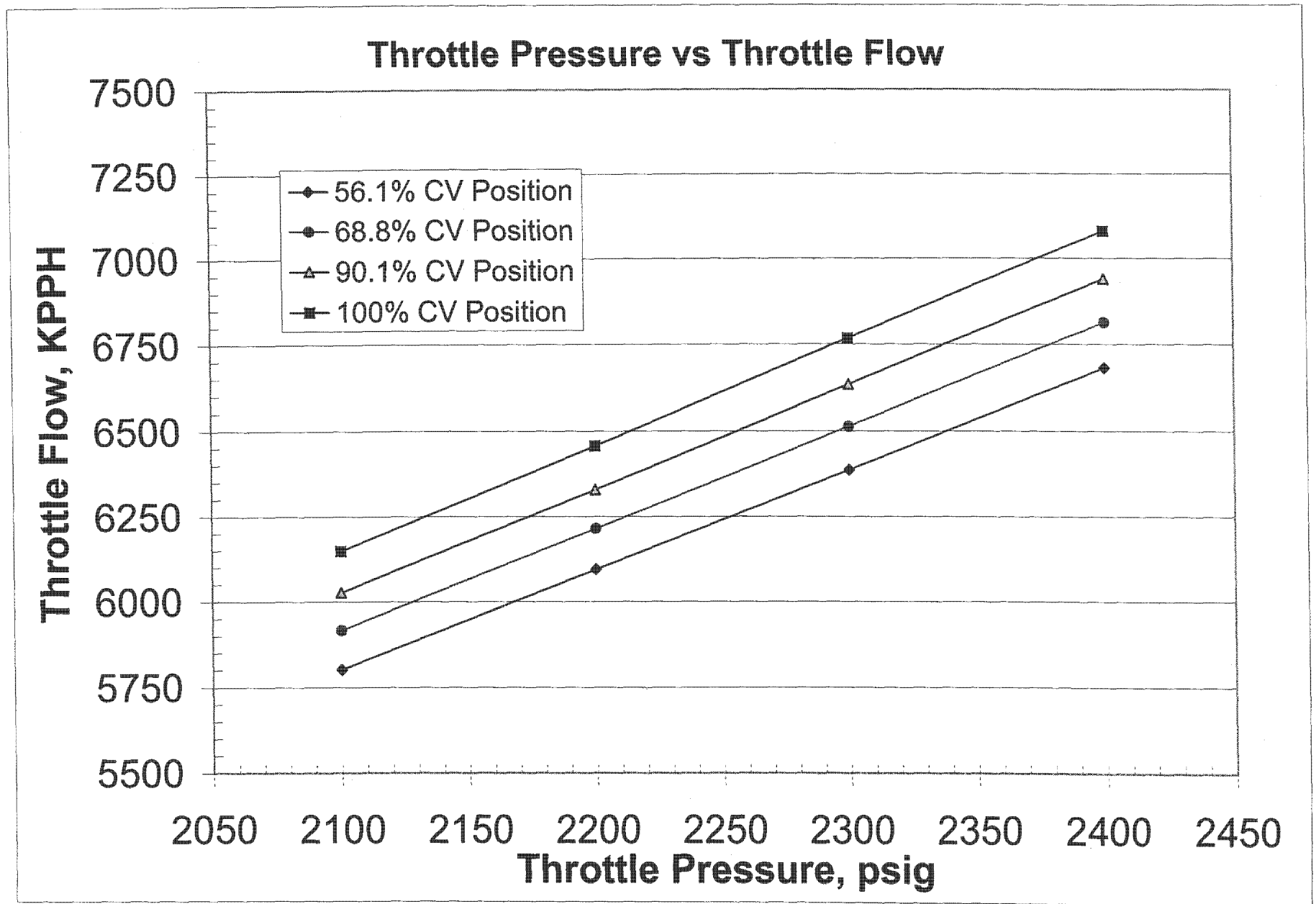
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Throttle Pressure vs Throttle Flow





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IP7011169

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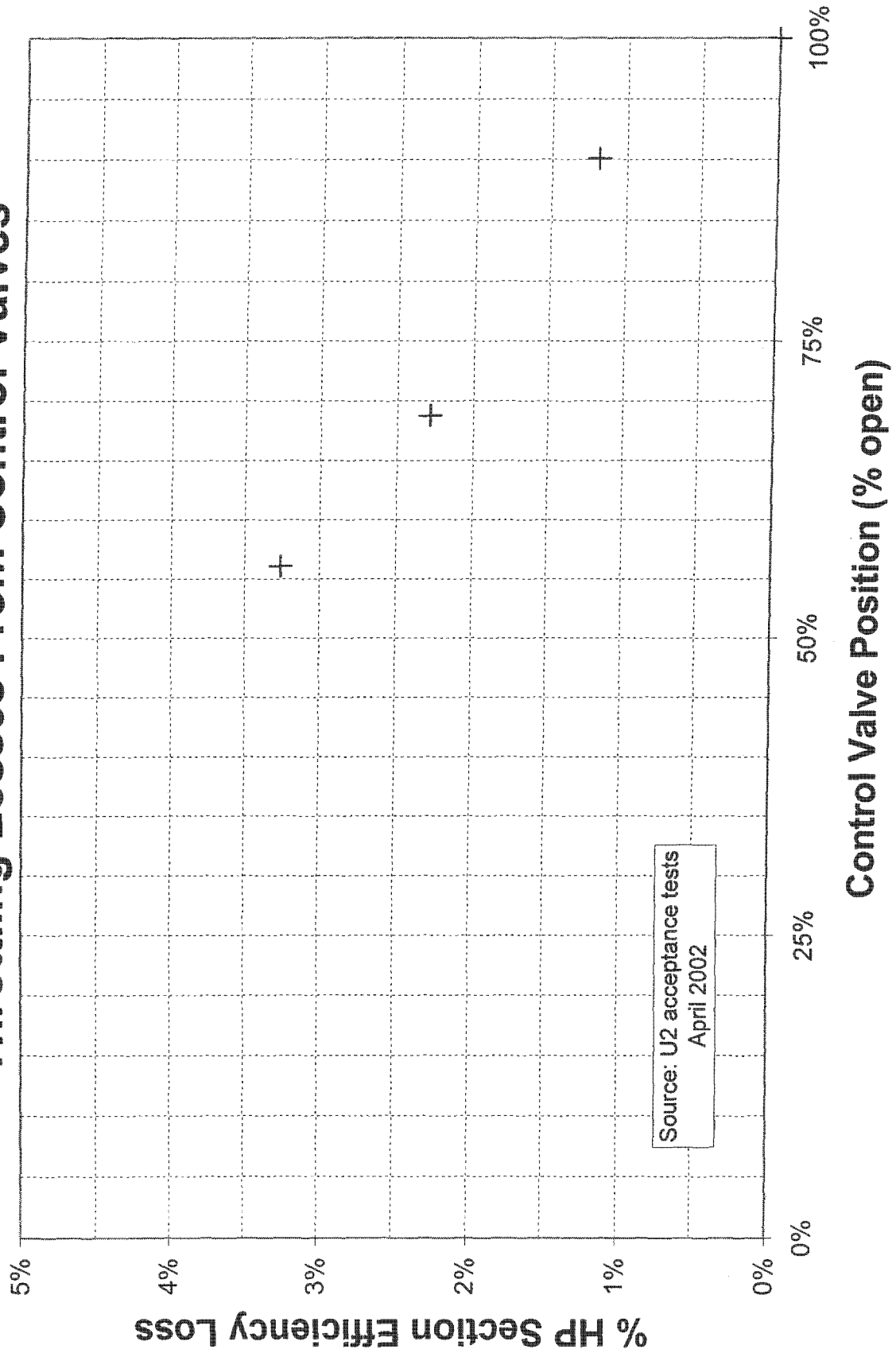
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IP7011170

Throttling Losses From Control Valves



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Gross Power (Mw)	989.4	989.5	987.8	988.2	988.7	973.2	875.3

Notes:

All tests conducted at turbine throttle valves wide-open.

Tests 7 & 8 conducted by PGT with test instrumentation. Refer to the Thermal Performance Test Results on Intermountain Power Project (IPP) Unit #2 Turbine Cycle test report (April 2002) for additional information.

Tests 9, 10 & upgrade tested using station instrumentation corrected to test instruments readings.

HP turbine efficiency - PGT test uncertainty $\pm 0.346\%$, enthalpy drop efficiency calculated with inlet conditions measured before stop valves, exhaust measured after balance gland leakage flow mix.

HP turbine wheel power - PGT test uncertainty $\pm 2.508\%$, throttle flow corrected to design conditions (2412.2 psia, 1000°).

Throttle flow - PGT test uncertainty $\pm 2.510\%$, corrected to design throttle conditions (2412.2 psia, 1000°).

IP turbine efficiency - Enthalpy drop efficiency calculated with inlet conditions measured before combined reheat valves and exhaust measured at LP-A turbine inlet (PGT), 14th stage extraction (Station).

Net turbine cycle heat rate - PGT test uncertainty $\pm 2.554\%$, test heat rate was adjusted to PGT test values and corrected to design throttle & reheat conditions, design turbine back-pressure, and contract cycle using station pepse model.

Gross power - PGT test uncertainty $\pm 0.459\%$, station measurement corrected to PGT test measurements and corrected to design throttle & reheat conditions, design turbine back-pressure, 6.9% reheat pressure drop, and contract cycle using station pepse model.

IP7011172

U2 HP Turbine Upgrade Acceptance Test Results Summary

	<u>Acceptance Tests</u>		<u>Confirmation Tests</u>				Pre-
	<u>Test 7</u>	<u>Test 8</u>	<u>Test 9</u>	<u>Test 10</u>	<u>Average</u>	<u>Gaurantee</u>	<u>Upgrade</u>
HP Turbine Efficiency (%)	92.85	92.83	92.72	92.80	92.80	92.20	83.48
HP Turbine Wheel Power (Mw)	302.8	304.5	300.4	304.4	303.01	299.0	259.4
Throttle Flow (kpph)	7,079	7,084	7,063	7,070	7,074	6,900	6,412
IP Turbine Efficiency (%)	92.01	92.06	92.17	91.05	91.82		91.23
Net Turbine Cycle Heat Rate (Btu/kwh)	7,701	7,636	7,671	7,676	7,671	7,683	7,807
Gross Power (Mw)	989.4	989.5	987.8	988.2	988.7	973.2	875.3

Notes:

All tests conducted at turbine throttle valves wide-open.

Tests 7 & 8 conducted by PGT with test instrumentation. Refer to the Thermal Performance Test Results on Intermountain Power Project (IPP) Unit #2 Turbine Cycle test report (April 2002) for additional information.

Tests 9, 10 & upgrade tested using station instrumentation corrected to test instruments readings.

HP turbine efficiency - PGT test uncertainty $\pm 0.346\%$, enthalpy drop efficiency calculated with inlet conditions measured before stop valves, exhaust measured after balance gland leakage flow mix.

HP turbine wheel power - PGT test uncertainty $\pm 2.508\%$, throttle flow corrected to design conditions (2412.2 psia, 1000°).

Throttle flow - PGT test uncertainty $\pm 2.510\%$, corrected to design throttle conditions (2412.2 psia, 1000°).

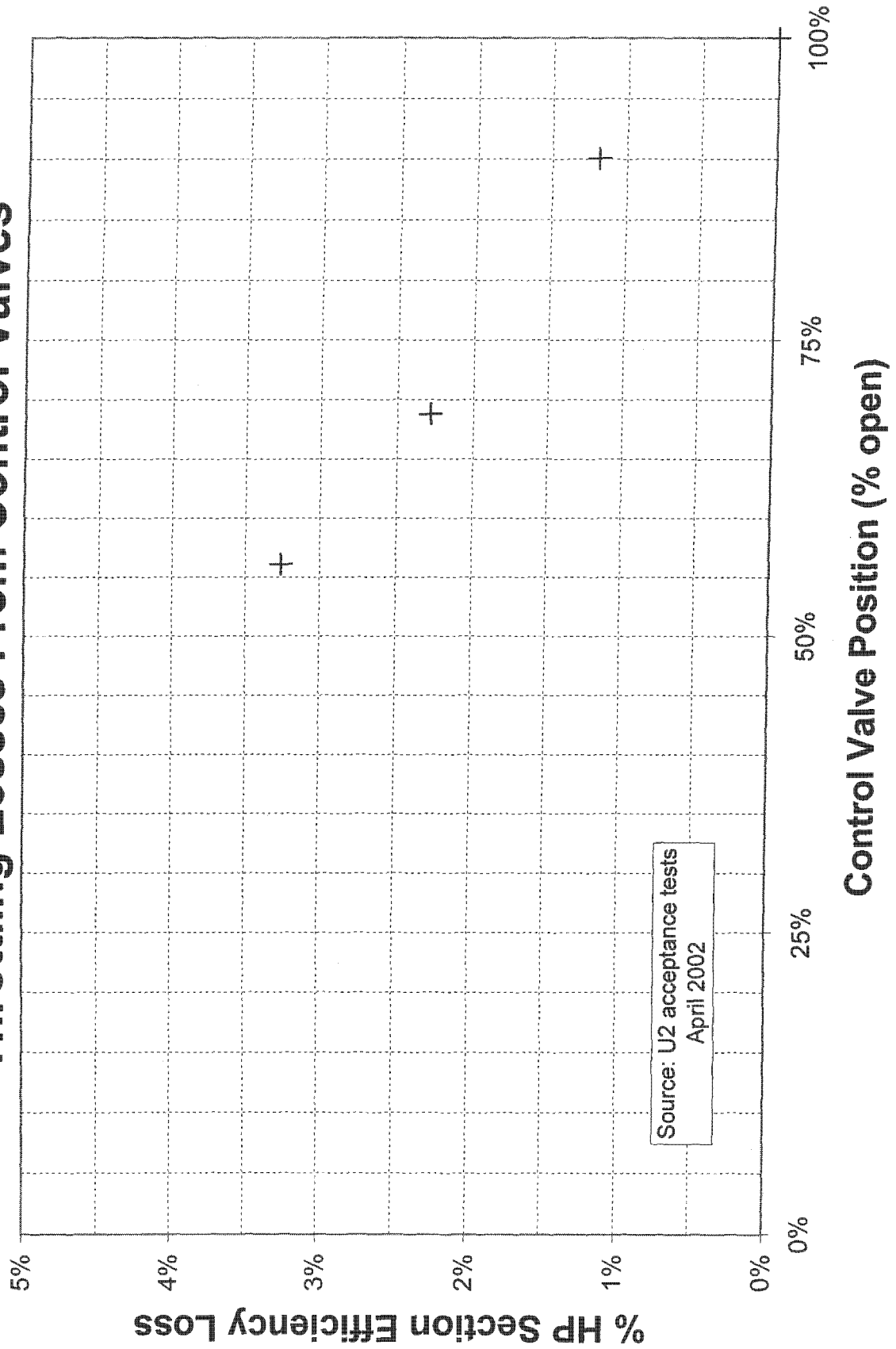
IP turbine efficiency - Enthalpy drop efficiency calculated with inlet conditions measured before combined reheat valves and exhaust measured at LP-A turbine inlet (PGT), 14th stage extraction (Station).

Net turbine cycle heat rate - PGT test uncertainty $\pm 2.554\%$, test heat rate was adjusted to PGT test values and corrected to design throttle & reheat conditions, design turbine back-pressure, and contract cycle using station pepse model.

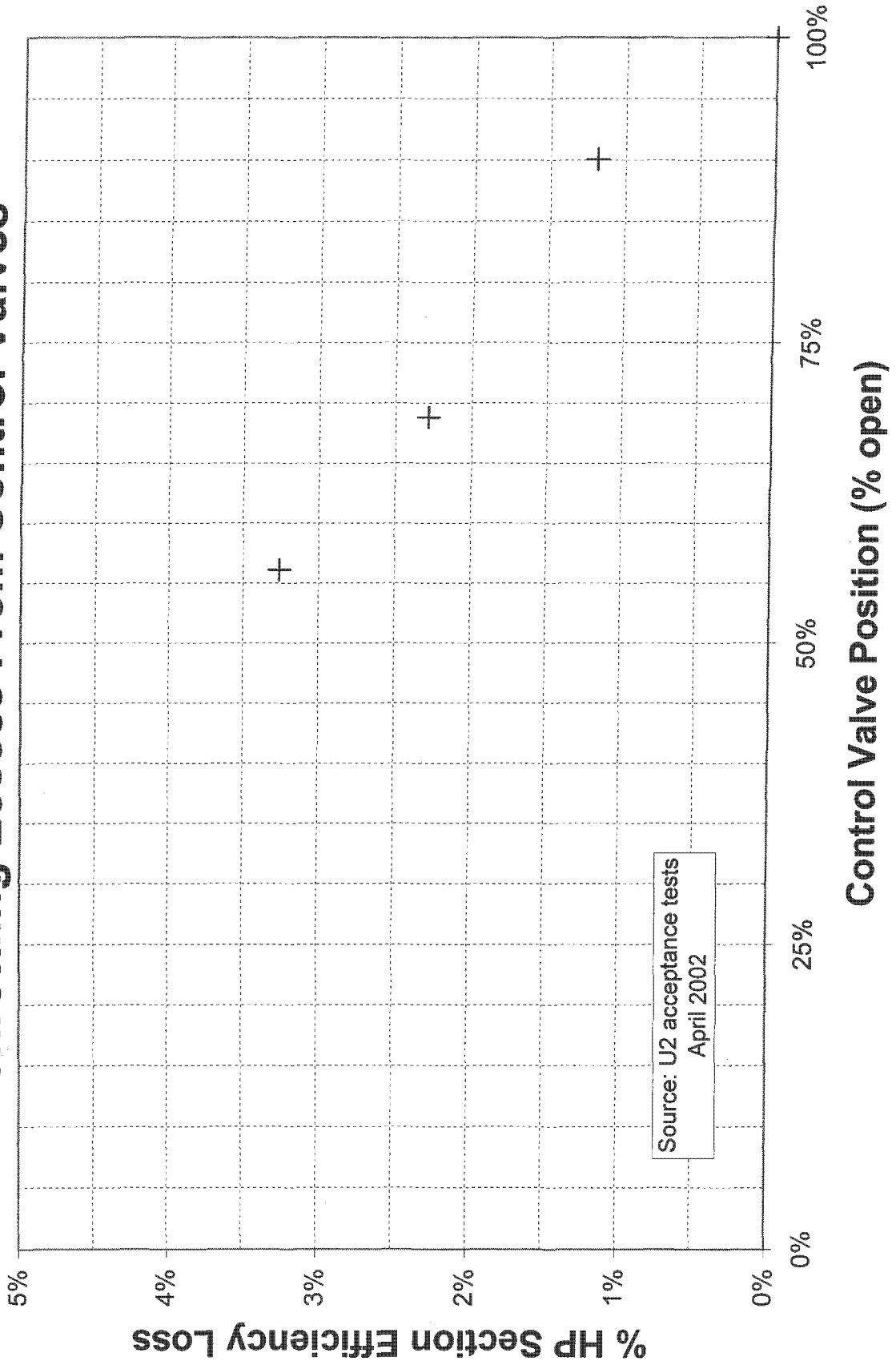
Gross power - PGT test uncertainty $\pm 0.459\%$, station measurement corrected to PGT test measurements and corrected to design throttle & reheat conditions, design turbine back-pressure, 6.9% reheat pressure drop, and contract cycle using station pepse model.

IP7011173

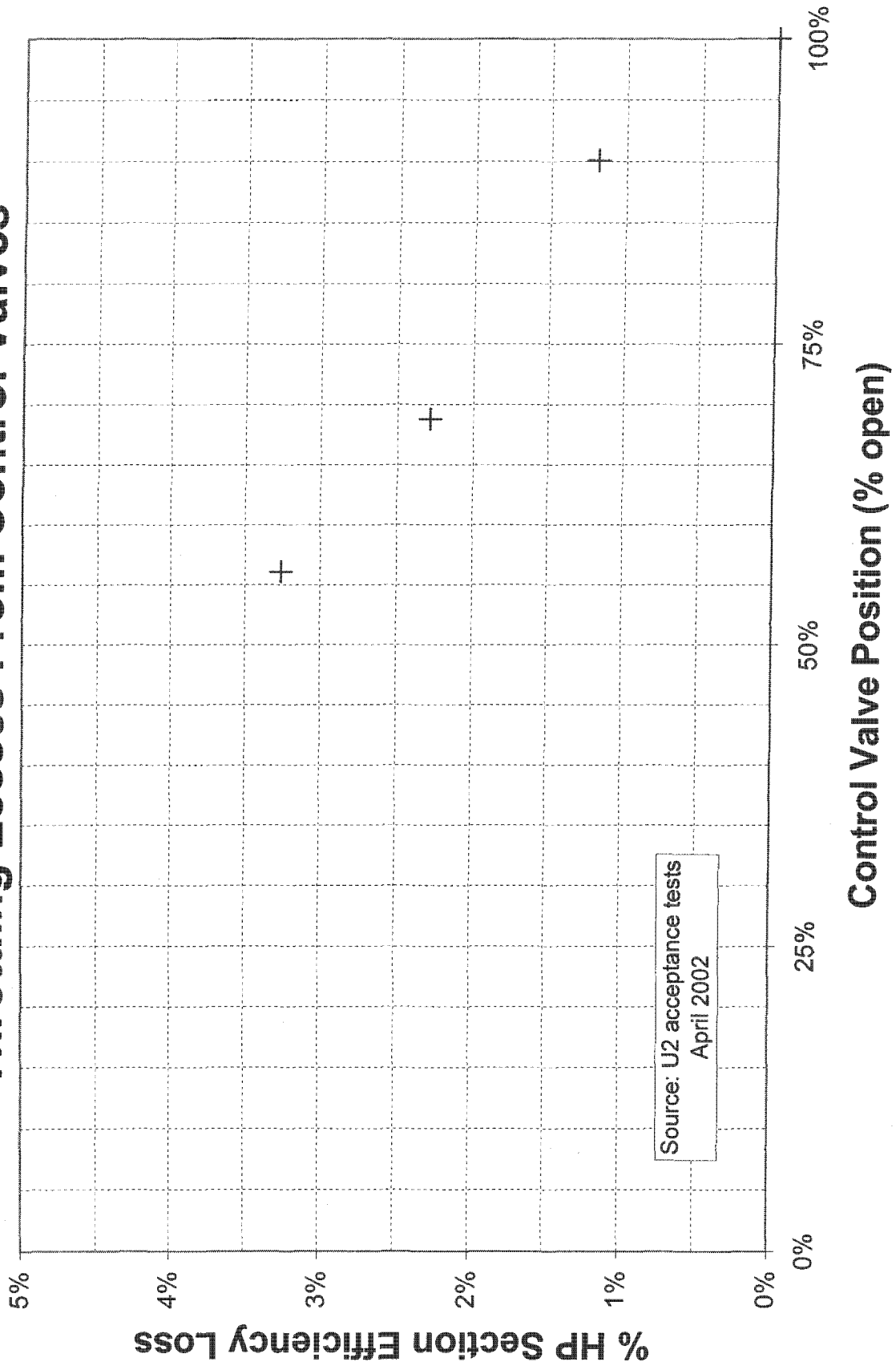
Throttling Losses From Control Valves



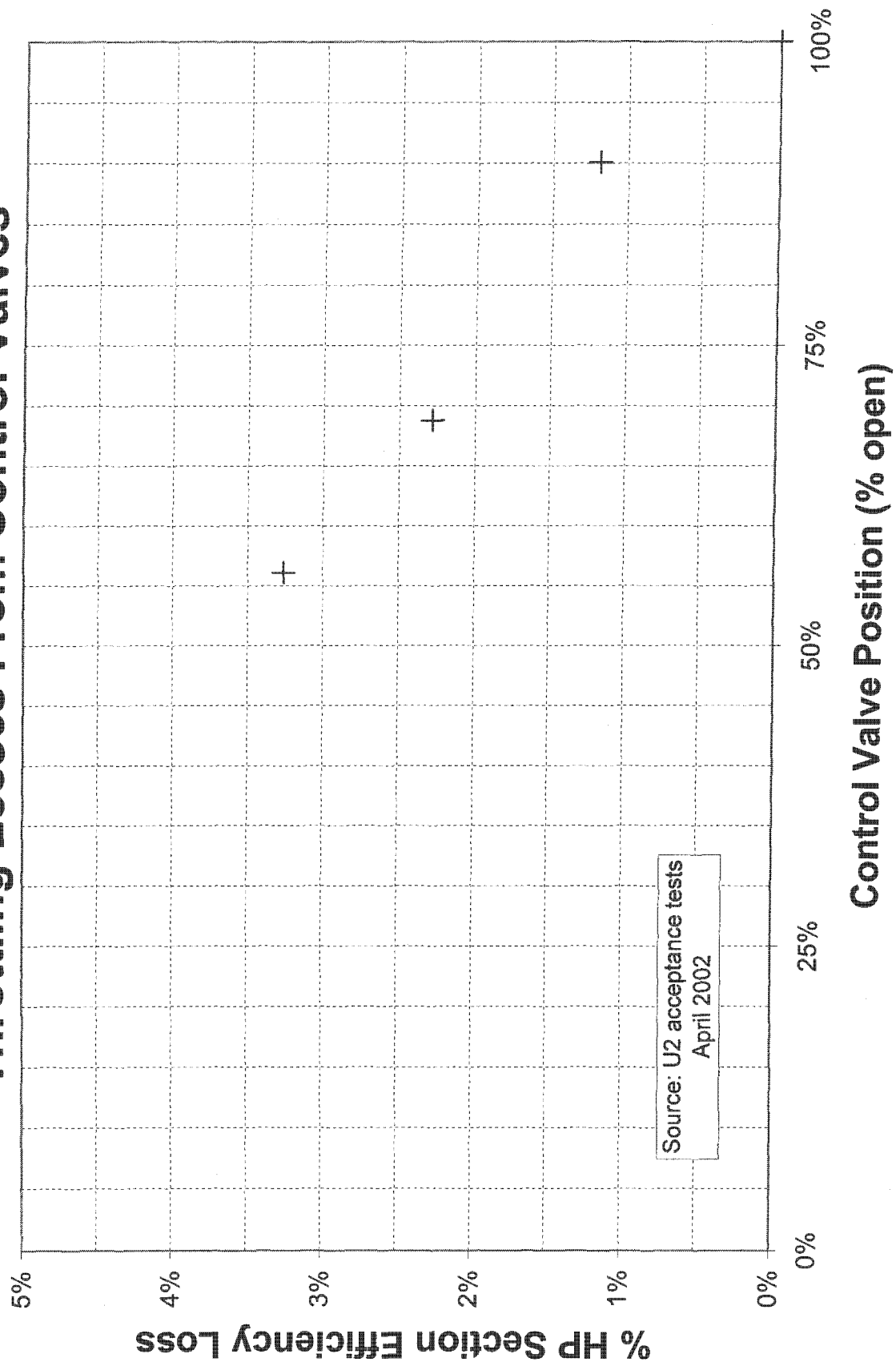
Throttling Losses From Control Valves



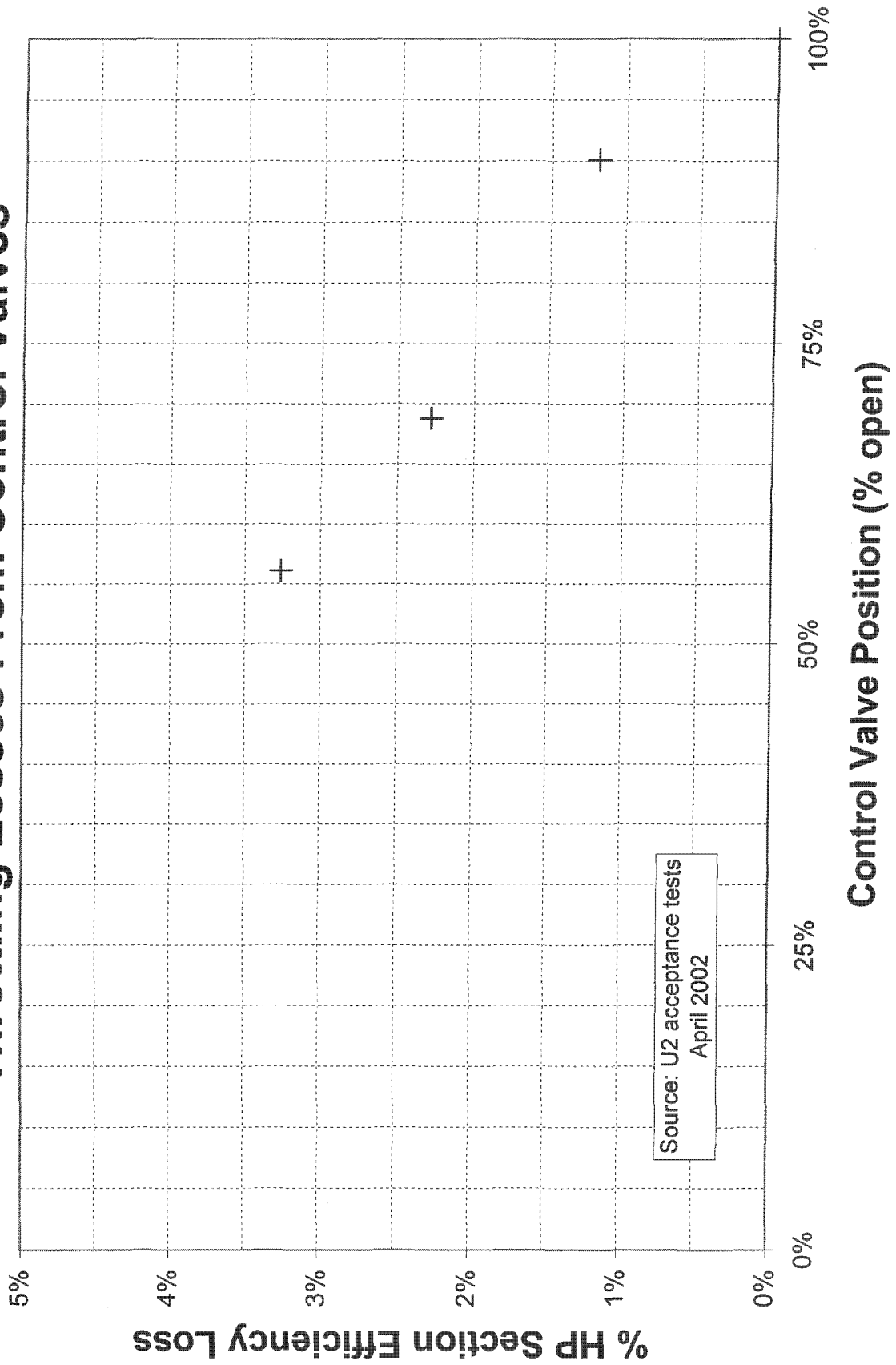
Throttling Losses From Control Valves



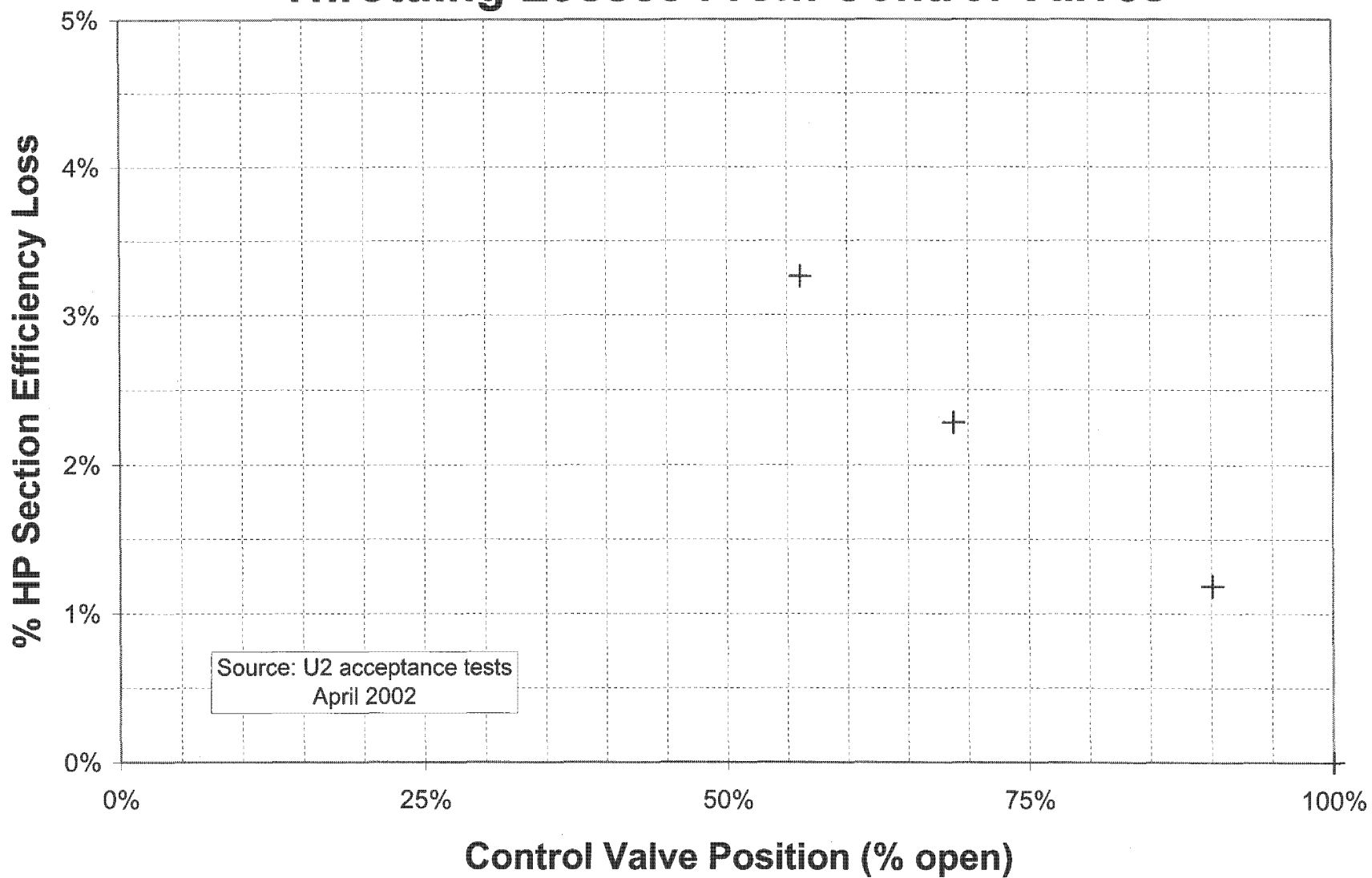
Throttling Losses From Control Valves



Throttling Losses From Control Valves



Throttling Losses From Control Valves



U2 HP Turbine Upgrade Acceptance Test Results Summary

	<u>Acceptance Tests</u>		<u>Confirmation Tests</u>		<u>Average</u>	<u>Guarantee</u>	<u>Pre-Upgrade</u>
	<u>Test 7</u>	<u>Test 8</u>	<u>Test 9</u>	<u>Test 10</u>			
HP Turbine Efficiency (%)	92.85	92.83	92.72	92.80	92.80	92.20	83.48
HP Turbine Wheel Power (Mw)	302.8	304.5	300.4	304.4	303.01	299.0	259.4
Throttle Flow (kpph)	7,079	7,084	7,063	7,070	7,074	6,900	6,412
IP Turbine Efficiency (%)	92.01	92.06	92.17	91.05	91.82		91.23
Net Turbine Cycle Heat Rate (Btu/kwh)	7,701	7,636	7,671	7,676	7,671	7,683	7,807
Gross Power (Mw)	989.4	989.5	987.8	988.2	988.7	973.2	875.3

Notes:

All tests conducted at turbine throttle valves wide-open.

Tests 7 & 8 conducted by PGT with test instrumentation. Refer to the Thermal Performance Test Results on Intermountain Power Project (IPP) Unit #2 Turbine Cycle test report (April 2002) for additional information.

Tests 9, 10 & upgrade tested using station instrumentation corrected to test instruments readings.

HP turbine efficiency - PGT test uncertainty $\pm 0.346\%$, enthalpy drop efficiency calculated with inlet conditions measured before stop valves, exhaust measured after balance gland leakage flow mix.

HP turbine wheel power - PGT test uncertainty $\pm 2.508\%$, throttle flow corrected to design conditions (2412.2 psia, 1000°).

Throttle flow - PGT test uncertainty $\pm 2.510\%$, corrected to design throttle conditions (2412.2 psia, 1000°).

IP turbine efficiency - Enthalpy drop efficiency calculated with inlet conditions measured before combined reheat valves and exhaust measured at LP-A turbine inlet (PGT), 14th stage extraction (Station).

Net turbine cycle heat rate - PGT test uncertainty $\pm 2.554\%$, test heat rate was adjusted to PGT test values and corrected to design throttle & reheat conditions, design turbine back-pressure, and contract cycle using station pepse model.

Gross power - PGT test uncertainty $\pm 0.459\%$, station measurement corrected to PGT test measurements and corrected to design throttle & reheat conditions, design turbine back-pressure, 6.9% reheat pressure drop, and contract cycle using station pepse model.

Based on PGT test Instr.

IP7011180

U2 HP Turbine Upgrade Acceptance Test Results Summary

	<u>Acceptance Tests</u>		<u>Confirmation Tests</u>		<u>Average</u>	<u>Gaurantee</u>	<u>Pre-</u>
	<u>Test 7</u>	<u>Test 8</u>	<u>Test 9</u>	<u>Test 10</u>			<u>Upgrade</u>
HP Turbine Efficiency (%)	92.85	92.83	92.72	92.80	92.80	92.20	83.48
HP TurbineWheel Power (Mw)	302.8	304.5	300.4	304.4	303.01	299.0	259.4
Throttle Flow (kp-ph)	7,079	7,084	7,063	7,070	7,074	6,900	6,412
IP Turbine Efficiency (%)	92.01	92.06	92.17	91.05	91.82		91.23
Net Turbine Cycle Heat Rate (Btu/kwh)	7,701	7,636	7,671	7,676	7,671	7,683	7,807
Gross Power (Mw)	989.4	989.5	987.8	988.2	988.7	973.2	875.3

Notes:

All tests conducted at turbine throttle valves wide-open.

Tests 7 & 8 conducted by PGT with test instrumentation. Refer to the Thermal Peerformance Test Results on Intermountain Power Project (IPP) Unit #2 Turbine Cycle test report (April 2002) for additional information.

Tests 9, 10 & upgrade tested using station instrumentation corrected to test instruments readings.

HP turbine efficiency - PGT test uncertainty $\pm 0.346\%$, enthalpy drop efficiency calculated with inlet conditions measured before stop valves, exhaust measured after balance gland leakage flow mix.

HP turbine wheel power - PGT test uncertainty $\pm 2.508\%$, throttle flow corrected to design conditions (2412.2 psia, 1000°).

Throttle flow - PGT test uncertainty $\pm 2.510\%$, corrected to design throttle conditions (2412.2 psia, 1000°).

IP turbine efficiency - Enthalpy drop efficiency calculated with inlet conditions measured before combined reheat valves and exhaust measured at LP-A turbine inlet (PGT), 14th stage extraction (Station).

Net turbine cycle heat rate - PGT test uncertainty $\pm 2.554\%$, test heat rate was adjusted to PGT test values and corrected to design throttle & reheat conditions, design turbine back-pressure, and contract cycle using station pepse model.

Gross power - PGT test uncertainty $\pm 0.459\%$, station measurement corrected to PGT test measurements and corrected to design throttle & reheat conditions, design turbine back-pressure, 6.9% reheat pressure drop, and contract cycle using station pepse model.

IP7011181